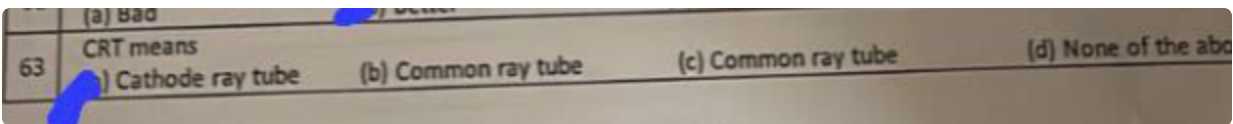


CH1 GRAPHICS

- **Computer graphics** is concerned with all aspects of producing pictures or images using a computer.
 - The field began humbly 50 years ago, with the display of a few lines on a cathode ray tube (CRT).
 - Currently, we can generate images by computer that are indistinguishable from photographs of real objects.

- مجال بیهتم ب ازای نرسم او نطلع صوره علی الکومپیوتر .. زمان کانوا بیعضروا خطوط بسیطه علی شاشه قدیمه (CRT) و دلوقتی الدنیا اتطورت و ممکن تشوف صوره معلومه بالکومپیوتر و تفتکرها صوره حقیقیه



Applications of Computer Graphics

- The applications of computer graphics are many and varied; we can, however, divide them into *four* major areas:

1. Display of Information
2. Design
3. Simulation and Animation
4. User Interfaces

هنمस्क کل واحد منهم نتکلم عنه

1- Display of Information

- The field of *scientific visualization* provides graphical tools that help researchers to interpret the vast quantity of data that they generate.

- فيه تخصص اسمه scientific visualization وده بيوفر أدوات جرافيكس بتساعد العلماء يفهموا كميات الداتا الكبيره اللي بيطلعوها من التجارب أو الأبحاث
- In fields such as *fluid flow*, *molecular biology*, and *mathematics*, images generated by conversion of data to geometric entities that can be displayed have yielded new insights into complex processes.
- في مجالات زي حركة السوائل و الأحياء الجزيئية والرياضيات العلماء بياخدوا الداتا ويحولوها لأشكال هندسية (زي رسومات أو موديلات 3D)، علشان يقدرُوا يشوفوا ويفهموا حاجات معقدة كانوا مش شايفينها قبل كده.
- The system used a *mathematical model* to generate the data
- بيقولك ان الكومبيوتر بيكون فيه معادلات رياضيه جاهزه (زي زي قوانين بتوصف حاجة بتحصل في الطبيعة) بيستخدمها علشان يقدر يحولك الداتا اللي بدخلها الي شكل رسمه

3. In field of, images generated by conversion of data to geometric entities that can be displayed have yielded new insights into complex processes.

- a) Biology
- b) scientific visualization
- c) **molecular biology**
- d) animation

7- The field of provides graphical tools that help researchers to interpret the vast quantity of data that they generate.

- (a) Mathematics
- (b) Fluid flow
- (c) **Scientific Visualization**
- (d) Biology

2- Design

- Professions such as engineering and architecture are concerned with design.
- مجالات زي الهندسه و المعماريه بتكون معتمده بشكل اساسي على التصميم
- Starting with a set of specifications, engineers and architects seek a cost-effective solution that satisfies the specifications.

- المهندس او المعماري ببداً من شويه متطلبات انه يحاول يطلع حل يكون عملي و رخيص و في نفس الوقت يحقق كل المطلوب
- Design is an **iterative process**. عمليه تكراريه
- **Rarely** in the real world is a problem specified such that there is a **unique optimal solution**.
- و لكن في الحياه الواقعيه نادر جدا ما تلاقي حل واحد مثالي للمشكله
- Design problems are either **overdetermined** such that they possess **no solution** that satisfies all the criteria, or **underdetermined**, such that they have **multiple solutions** that satisfy the design criteria.
- عندنا مشكلتين بيظهروا في التصميم بيكونوا مرتبطين بالمتطلبات بتاعت التصميم (الاتنين عكس بعض)
- الاولى **overdetermined** و هي ان الحاجات المطلوب تنفيذها في التصميم كثير جدا و في كذا شرط فا صعب تلاقي حل واحد يقدر يحقق كل الشروط دي مع بعض
- الثانيه **underdetermined** دي بتكون فيها الشروط قليله او بسيطه فا بتالي ممكن تتطلع اكثر من حل ممكن
- The designer works in an iterative manner.
- He/She **generates** a possible design, **tests** it, and then **uses the results** as the basis for **exploring other solutions**

4. Design problems that are have multiple solutions that satisfy the design criteria
a) **overdetermined**

Answer : underdetermined

37 | Design is an _____ process.
a) Iterative b) Easy c) Noisy d) Modern

- Today, the use of **interactive graphical tools** in **computer-aided design (CAD)** pervades fields such as:
 1. Architecture
 2. The design of mechanical parts
 3. **Very-large-scale integrated (VLSI) circuits** الدوائر الالكترونيه المعقده

3- Simulation and Animation

- Once graphics systems evolved to be capable of generating sophisticated (معقده) images in real time, designers and researchers began to use them as simulators.
- Graphical *flight simulators* have proved both to increase safety and to reduce training expenses.
- The use of special VLSI chips has led to a generation of *arcade games* as sophisticated as flight simulators
- لما مجال الجرافيكس اطور لدرجه انه بقا قادر يطلع صور معقده المصممين بدأوا يعملوا محاكاة للحاجات اللي موجوده في الواقع فا استعملوها في اجهزه المحاكاه الخاصه بالطيران اللي بتخلي الطيار يدرب على القيادة و دا اكيد بيكون آمن اكتر و اقل تكلفه.. و بعدين استخدموا ال VLSI chips علشان يعملوا العاب الاركيد

4- User Interface

- Our interaction with computers has become dominated by a visual paradigm that includes windows, icons, menus, and a pointing device, such as a mouse.
- ال Visual Paradigm يعني اننا بنتفاعل مع الكومبيوتر من خلال الحاجات اللي بنشوفها و نضغط عليها
- *From a user's perspective*, windowing systems such as Microsoft Windows, and the Macintosh Operating System differ only in details.
- من وجهه نظر المستخدم العادي ان انظمه التشغيل تعتبر شكلهم قريب من بعض جدا و الاختلافات بينهم في تفاصيل بسيطه جدا
- More recently, millions of people have become users of the Internet.
- Their access is through graphical network browsers, such as Firefox, Chrome, Safari, and Internet Explorer, that use these same interface tools

The GUI consists of different icons such as:

1. Program icons.
2. Object icons.
3. Menu icons.

4. Check-Box icons

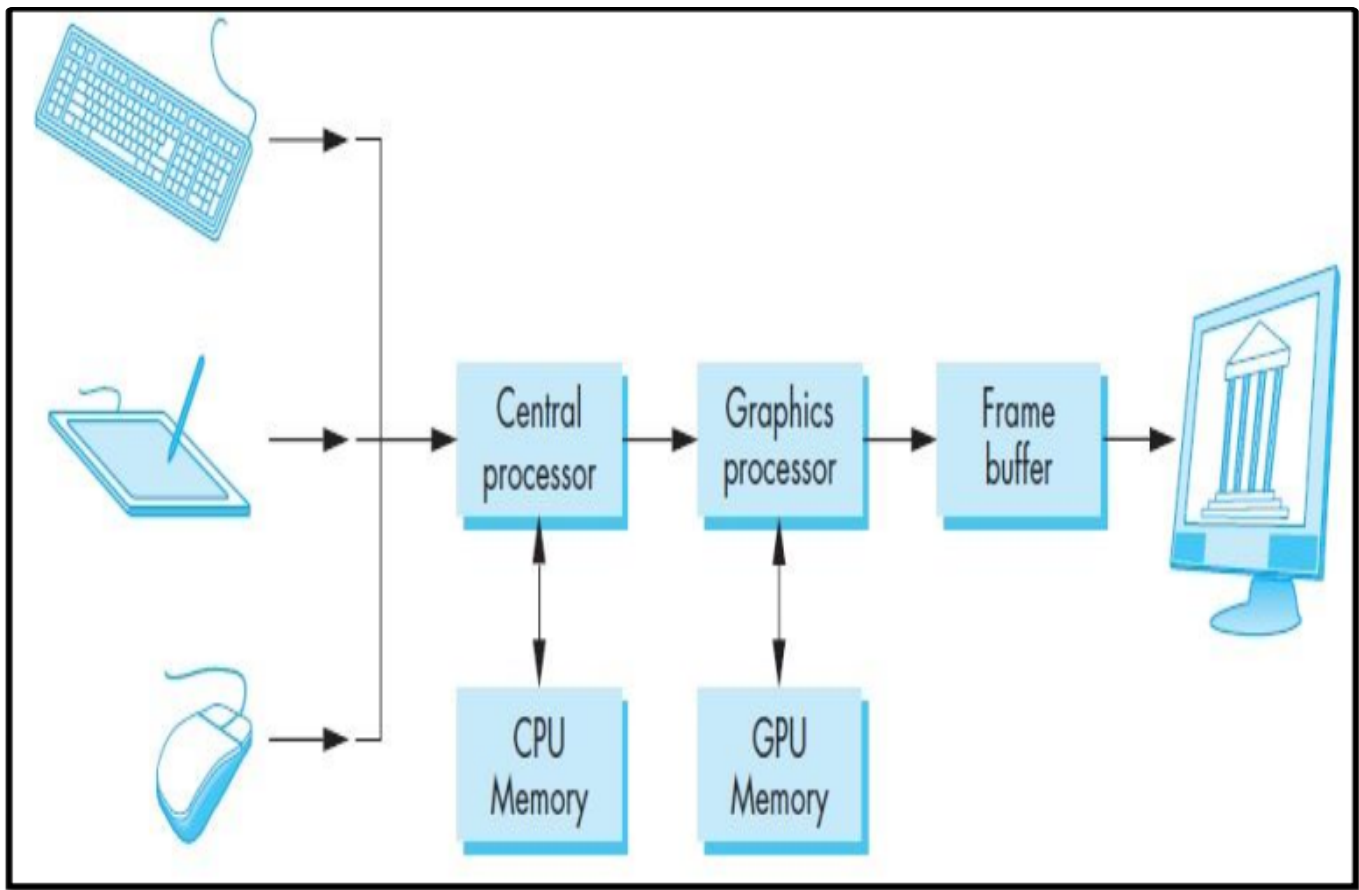
5. Spinner icon

2. Our interaction with computers has become dominated by a visual paradigm that includes windows, icons, menus and pointing device, such as a mouse that is called
- a) Simulation
 - b) Animation
 - c) User Interfaces
 - d) Programming

Graphic System

- A computer graphic system is a computer system; as such, it must have all the components of a general-purpose computer system.
- نظام الجرافيكس اللي في الكمبيوتر هو في الأساس نظام كمبيوتر عادي يعني لازم يكون فيه كل المكونات اللي أي كمبيوتر بيحتاجها

high-level view of a graphics system



There are **six** major elements in our system:

1. Input devices
2. Central Processing Unit
3. Graphics Processing Unit
4. Memory
5. Frame buffer
6. Output devices

هنمסק بردو کل وحد نتکلم عنه بس بعد الحته اللي جايه

Pixels and the Frame Buffer

- The image we see on the output device is an array—the raster—of picture elements, or pixels, produced by the graphics system.
- الصورة اللي بنشوفها عبارة عن مجموعة من البيكسلات جنب بعض في ترتيب معين بنسميه Raster يعني كأنها شبكة مرصوفة صفوف و اعمده

- the pixels are stored in a part of memory called the *frame buffer*
- The depth, or precision, of the frame buffer, defined as the number of bits that are used for each pixel.

- كل بيكسل متخزن في ال frame buffer ليه عدد معين من البتات و كل ما عدد البتات زاد كل ما قدرت تطلع اللون اكثر و تفاصيل اكثر

Bit Depth	Number of Possible Colors	Available Binary Combinations for Describing a Color
1-bit	2	0, 1
2-bit	4	00, 01, 10, 11
4-bit	16	0000, 0001, 0011, 0111, 1111, 0010, 0100, 1000, 0110, 1100, 1010, 0101, 1110, 1101, 1001, 1011

- These picture elements (known as *pels* or, more commonly, pixels) can be either on or off, as in the 1 bit bitmap.
- By using more bits to describe them, can represent varying shades of color
- لو عندك 1 بت يبقى 2^1 يبقى معاك لونين بس (ابيض و اسود) لو عندك 2 بت يبقى 2^2 يبقى معاك 4 اللون و هكذا ..
- In *full-color systems*, there are 24 (or more) bits per pixel. Such systems can display sufficient colors to represent most images realistically

	a) CIVIL AIR HIGH	b) ROAD AIR HIGH	c) ROAD AIR CIVIL	d) HIGH AIR HIGH
3	Raster graphics are composed of _____.			
	a) Pixels	b) Paths	c) Palette	d) None of these
	Which of the following properties is followed by the ellipse?			

- 4- In full-color systems, there are bits per pixel.
- (a) 22 (b) 16 (c) 24 (d) 128
- 5- A decides which primitives, or parts of primitives,

9. In a/an frame buffer only two colors are used.
- a) 1-bit-deep
b) 2-bit-deep
c) 4-bit-deep
d) 8-bit-deep

5. is the part of the memory where the pixels are stored in

- a) Depth
- b) **Frame buffer**
- c) Resolution
- d) Precision

7. is the number of bits that are used for each pixel which determines properties such as how many colors can be represented in a given system.

- a) **Depth**
- b) Frame buffer
- c) Resolution
- d) Full-color

70	☒ True	(b) False
	Color depth can be defined by _____ which can be displayed on a display unit.	
71	☒ Bits per pixel	(b) Bytes per pixel (c) Megabyte per pixel (d) None of these

The CPU and the GPU

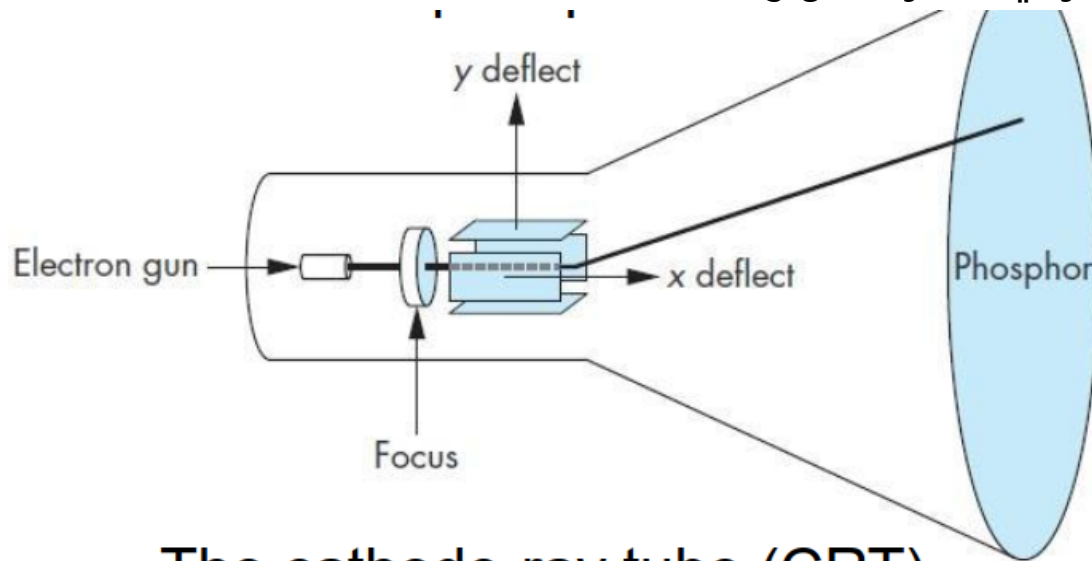
- In a *simple system*, there may be only one processor, the (CPU) of the system, which must do both the normal processing and the graphical processing.
- في الاجهزة البسيطة سيكون فيها معالج واحد بس (اللي هو ال CPU) و هو اللي بيشتغل في كل حاجة
- The graphical function of the processor is to take specifications of graphical primitives and to assign values to the pixels in the frame buffer
- ال graphical function وظيفته انه ياخذ البيانات الخاصه بالرسمه (graphical primitives) و يحط قيم كل البيكسل المتخزنه في ال frame buffer

Output Devices

- Until recently, the dominant type of display (or monitor) was the *cathode-ray tube (CRT)*.
- When electrons strike the phosphor coating on the tube, light is emitted.
- The output of the computer is converted, by *digital to-analog converters* to

voltages across the x and y deflection plates

- Light appears on the surface of the CRT when a sufficiently intense beam of electrons is directed at the phosphor
- زمان، أغلب الشاشات اللي كنا بنستخدمها كانت من نوع اسمه CRT (فصل الفيزيا الحديثه 3ث يتصل بك)
- بيقولك ان الجهاز نفسه بيكون شغال بالبيانات الرقميه (digital) بس الشاشه محتاجه اشارات كهريبيه (analog) علشان تعرف هتبعث فين الالكترونات
- فبيحصل تحويل للبيانات الرقميه دي عن طريق حاجه اسمها digital to-analog converters و بعددين يتحكموا في الجهد الكهربى (voltage) اللي هيروح للوحين جوه الشاشه واحد بيحرك الالكترونا يمينك و شمال (X) و التاني بيحركها فوق و تحت (Y)
- الصوره او اللون بيظهر على الشاشه بعد ما شعاع الالكترونات يخط في طبقه الفسفور اللي جوه الشاشه
- المهم من الرغبي دا تعرف بس وظيفه ال digital to-analog converters



The cathode-ray tube (CRT).

35

Input Devices

- Most graphics systems provide a keyboard and at least one other input device
- The most common input devices are the mouse, the joystick, and the data tablet.
- These devices allow a user to indicate a particular location on the display

Images: Physical and Synthetic

- In modern systems, we want to exploit (نستغل) the capabilities of the software and hardware to create realistic images of computer-generated three dimensional objects
- This task involves many aspects of image formation, such as lighting, shading, and properties of materials
- احنا بنحاول نستغل قدرات السوفت وير و الهارد وير علشان نعمل صوره شكلها واقعي و نعمل مجسمات ثلاثيه الابعاد فا علشان كذا بنهتم بكام حاجه زي الازياء و الظل و خواص المواد (هل سطح المجسم لامع؟ خشن؟ شفاف؟)

Objects and Viewers

- *Two basic entities must be part of any image-formation Process:* Object and Viewer.
- We form objects by specifying the positions in space of various geometric primitives, such as points, lines, and polygons.
- To form an image, we must have someone or something that is viewing our objects.
- احنا بنرسم اي object عندنا بشويه خطوط و دواير و علشان نرسمه بردوا لازم يكون في حد او حاجه بتبص على الobject دا علشان نحدد الاتجاهات و الكلام دا
- It is the viewer that forms the image of our objects

Light and Images

- If there is no light source, the objects would be dark, and there would be nothing visible in our image.
- We must indicated how the color enters the picture or what the effects of the surface properties of the objects are
- لازم نحدد حاجتين الاولى هي اللون بيوصل ازاى للصورة ؟ و الثانيه ازاى شكل سطح المجسم بيتأثر؟
- **The visible spectrum**, which has wavelengths in the range of 350 to 780 nanometers (nm), is called (visible) light.

11- The visible spectrum has wavelengths in the range of nanometers (nm)
(a) 800 to 910 (b) 100 to 209
(c) 350 to 780 (d) 210 to 290

Imaging Systems

- We now introduce two imaging systems:
 - ✓ The pinhole camera الكاميرا ذات الثقب
 - ✓ The human visual system. نظام الرؤية البشري
- **The pinhole camera:** is a simple example of an imaging system that will enable us to understand the functioning of cameras and of other optical imagers
 - A pinhole camera is a box with a small hole in the center of one side of the box.
 - The *film* is placed inside the box on the side opposite the pinhole.
 - The film plane is located a distance *d* from the pinhole.
- هي كاميرا من غير عدسة، بس فيها فتحة صغيرة جدًا والضوء بيدخل منها ويكوّن صورة مقلوبة على الناحية الثانية
- ال *d* بتعبر عن المسافه بين ما بين الفاتحه و المكان اللي في الصندوق اللي هيظهر عليه الصور (Film)
- عندنا معادله بنستخدمها علشان نحسب مكان الصورة على ال film اللي هيظهر عليه الصورة

$$y_p = -\frac{y}{z/d}$$

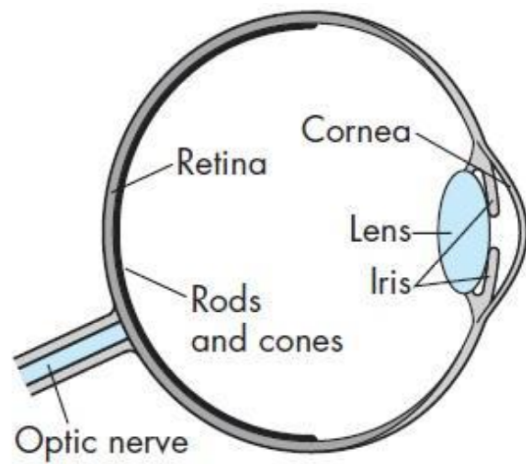
- ال *Y* اللي في البسط بتعبر عن طول الجسم و ال *Z* هي المسافه بين الجسم و الكاميرا و ال *d* هي المسافه بين الفتحة و ال film و الاشاره السالب لاننا قولنا ان الصورة بتطلع مقلوبه

Camera Specifications

- في 4 حاجات مهمين لاوم: we can identify four types of necessary specifications: نحدداهم لما نيجي نصمم او نحسب حاجه في الكاميرا ذات الثقب
 - الموقع Position
 - الاتجاه Orientation
 - البعد البؤري (المسافه بين الثقب لحد الفيلم اللي هتتكون عليه Focal length (الصورة)
 - مستوى الفيلم Film plane

The Human Visual System

- Our extremely complex visual system has all the components of a physical imaging system, such as a camera or a microscope. النظام البصري بتاعنا فيه كل المكونات اللي موجودة في أي نظام تصوير زي الكاميرا.
- Light enters the eye through the *lens* (العدسه) and *cornea* (القرنيه)
- The *iris* (القزحيه) opens and closes to adjust the amount of light entering the eye
- The *lens* forms an image on a two-dimensional structure called the *Retina* (الشبكيه) at the back of the eye.
- عدسه العين بتكون الصوره على سطح مسطح جوه العين اسمه الشبكيه
- The *rods and cones* are light sensors and are located on the retina.
- جوه الشبكيه في عندنا ال Rods (العُصَيَّات) و ال Cones (الأقماع) و دول هما اللي بيستقبلوا الضوء
- The sizes of the *rods and cones* determine the resolution of our visual systems
- جودة الصورة اللي عينك بتشوفها (يعني الوضوح أو ال resolution) بتعتمد على حجم وعدد ال rods وال cones.



The human visual system

- 8- is the number of pixels in the frame buffer which determines the detail you can see in the image.
- (a) Resolution (b) Depth
(c) Contrast (d) Illumination
- 9- The allows the user to indicate a position on the screen.

6. determines the detail that you can see in the image
- a) Depth
b) Frame buffer
c) Resolution
d) Precision

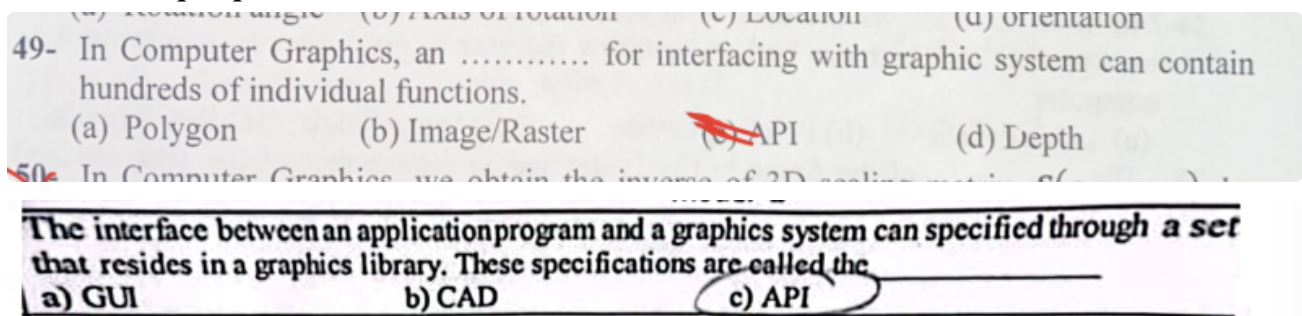
The Programmer's Interface

- In a typical application the user sees menus and icons that represent possible actions.
- By clicking on these items, the user guides the software and produces images without having to write programs. لما المستخدم يضغط على زر هو كده بيتحكم في البرنامج وبيخله يرسم أو يعمل حاجة معينة.
- The interface between an application program and a graphics system can be specified through a set of functions that resides in a graphics library.
- These specifications are called the *application programming interface (API)*.

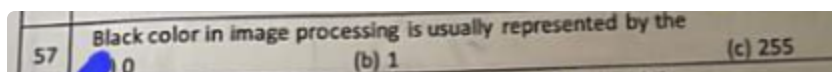
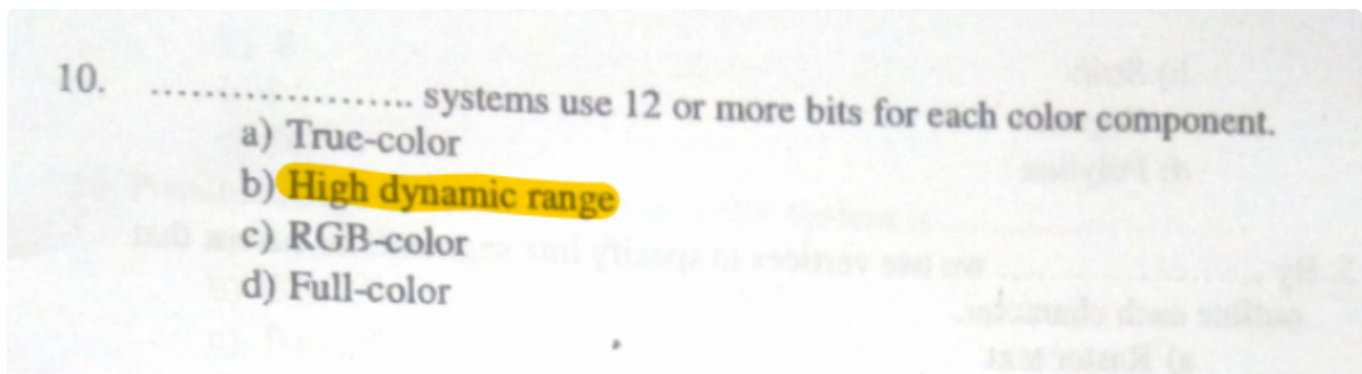
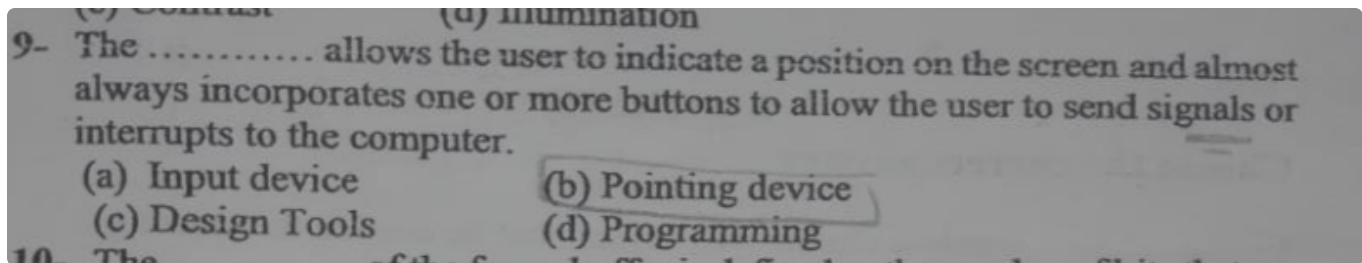
- أنت كمبرمج بتكتب Application Program و البرنامج بتاعك بيستخدم دوال جاهزة من Graphics Library (اللي هي API)

Three-Dimensional APIs

- If we are to follow the synthetic-camera model, we need functions in the API to specify the following:
 - Objects
 - A viewer
 - Light sources
 - Material properties



Questions :-



61	(a) Rotation	(b) Scaling	(c) Translation	(d) All of the above
62	Higher the number of pixels, _____ the image quality.	(a) Bad	(b) Better	(c) Smaller
78	(a) $2(\theta_1 + \theta_2)$	(b) $\theta_1 - \theta_2$	(c) $\theta_1 + \theta_2$	(d) $\theta_2 - \theta_1$
79	The main element of a video monitor is the _____	(a) RAT	(b) DCT	(c) CRT

Model-2

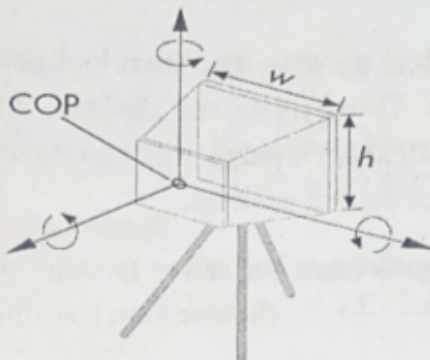
Which of the following options is not correct according to the definition of Computer Graphics?

- a) Computer Graphics is used for animation purposes.
- b) Computer graphics can be used to provide better user interface.
- c) Computer graphics can improve the sound quality of a video.
- d) None of the above

35	Vector and _____ are the two types of computer graphics.	(a) Polygon	(b) Sector	(c) Polyline	(d) Depth
		a) Scalar	b) Sector	c) Rector	d) Raster

39- In Computer Graphics, primitives could be separated into two classes: geometric primitives and primitives.

- (a) Polygon
- (b) Image/Raster
- (c) Polyline
- (d) Depth



54- The usually is given by the position of the center of the lens, which is the center of projection (COP).

- (a) Camera location
- (b) Orientation
- (c) Resolution
- (d) Depth

55- Once we have positioned the camera, we can place the, or a camera coordinate system with its origin at the center of projection. We can then rotate the camera independently around the three axes of this system.

- (a) Camera location
- (b) Orientation
- (c) Hight
- (d) Shift

56- The of the lens determines the size of the image on the film plane or, equivalently, the portion of the world the camera sees.

- (a) Orientation
- (b) Camera location
- (c) Focal length
- (d) Depth

